A Dynamic Shoreline

Working to understand the past, present, and future of the dynamic shoreline at Illinois Beach State Park

September 11, 2020

> *This story map was assembled as part of a collaborative venture between the Illinois Department of Natural Resources (IDNR) Coastal Management Program (CMP) and the Illinois State Geological Survey (ISGS) through the Prairie Research Institute (PRI). It reflects the current thinking of the ISGS staff regarding shoreline dynamics at Illinois Beach State Park (IBSP).*

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES

COASTAL Management Program
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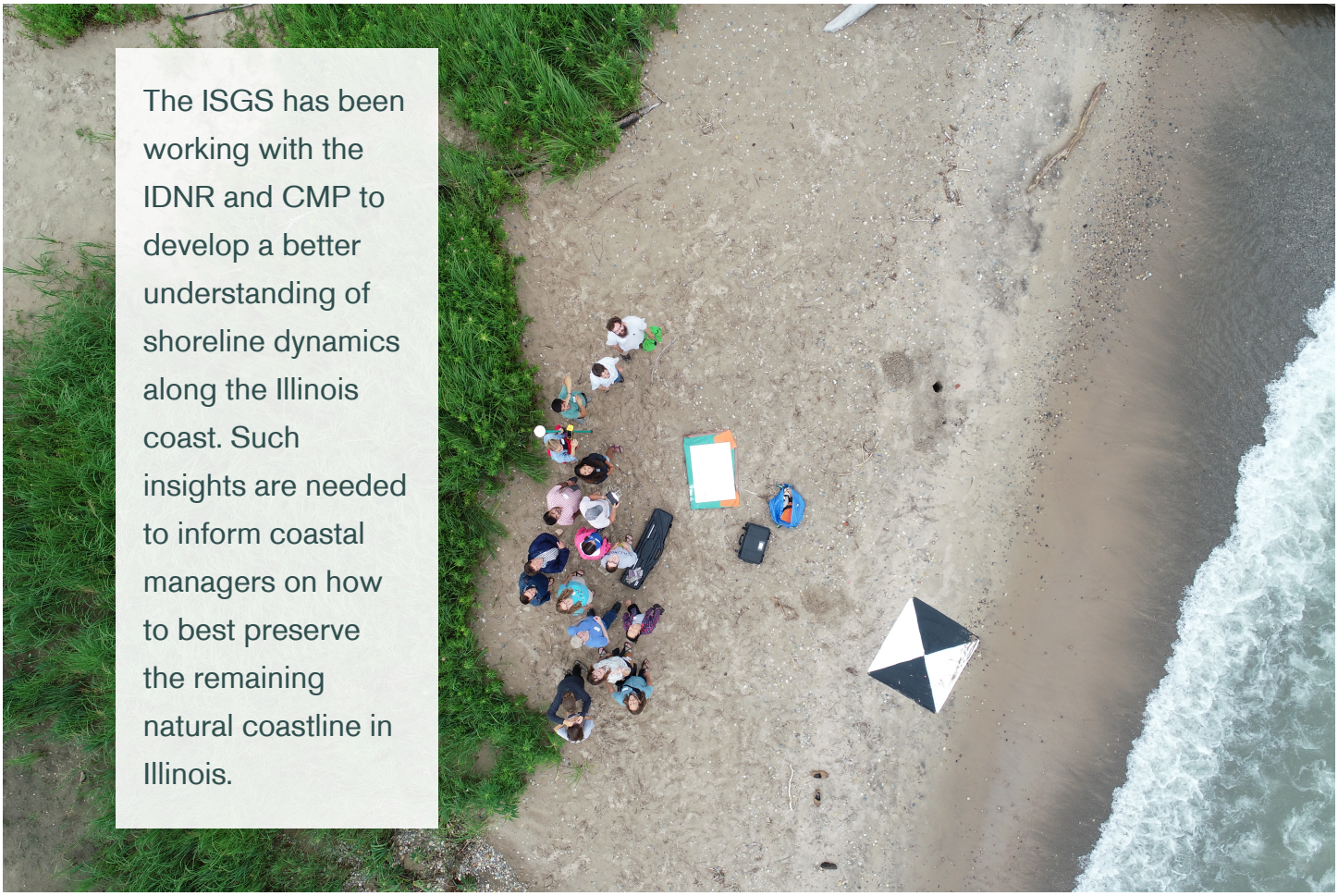
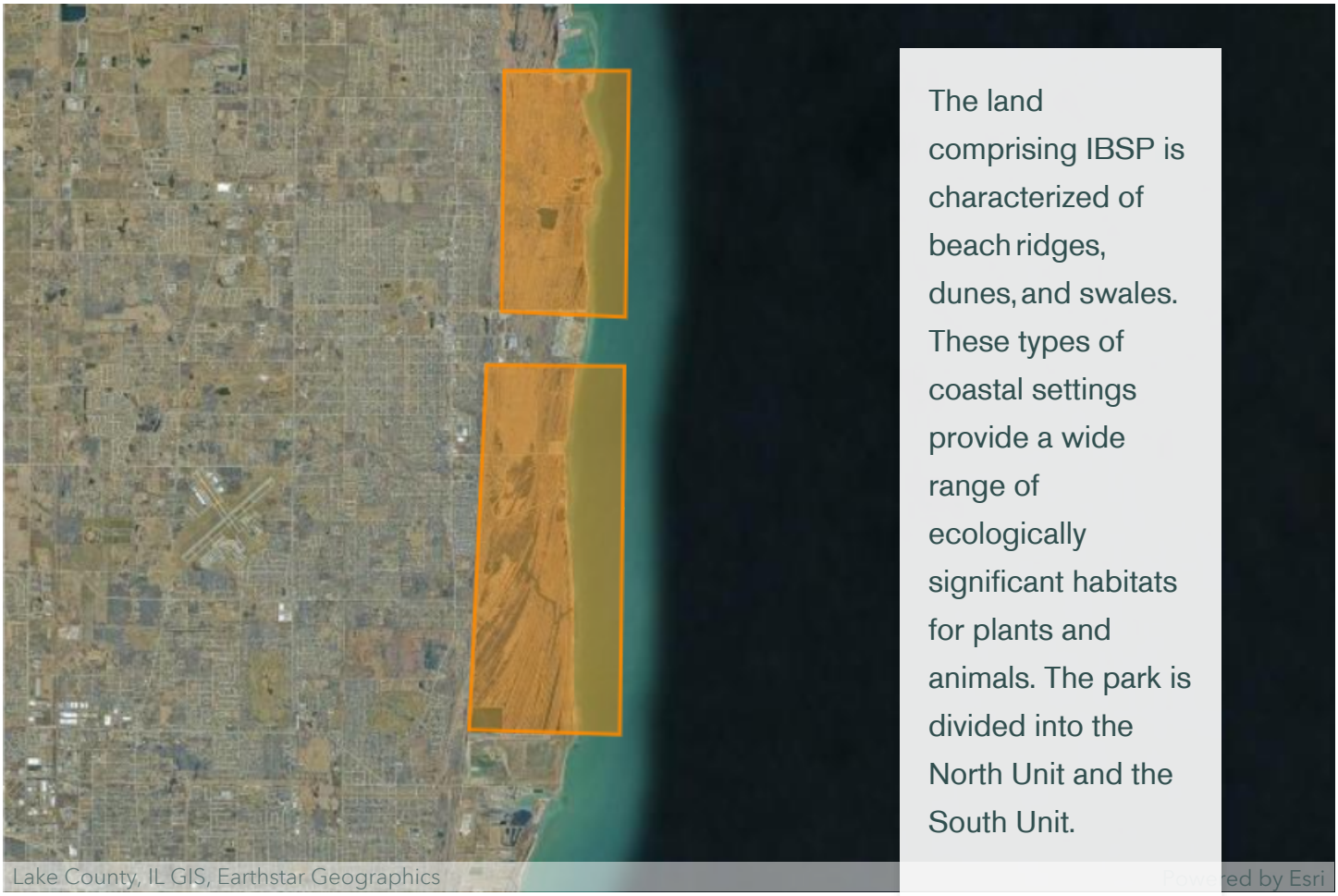
Overview

The slideshow below provides an overview of the research area and efforts at IBSP



These efforts have focused on Illinois Beach State Park (IBSP), located near Zion, IL. This unique part of our coast encompasses 6.5 miles of mostly undeveloped shoreline.



The land comprising IBSP is characterized of beach ridges, dunes, and swales. These types of coastal settings provide a wide range of ecologically significant habitats for plants and animals. The park is divided into the North Unit and the South Unit.

The shoreline of the North Unit has been experiencing **erosion (**the removal of sediment), while the shoreline along much of the South Unit has been experiencing **accretion** (the accumulation of sediment). This pattern relates to **littoral drift**, the natural southward movement of sand alongshore by waves and

currents. Changes in land use and shoreline infrastructure have fragmented this natural process along the coast.

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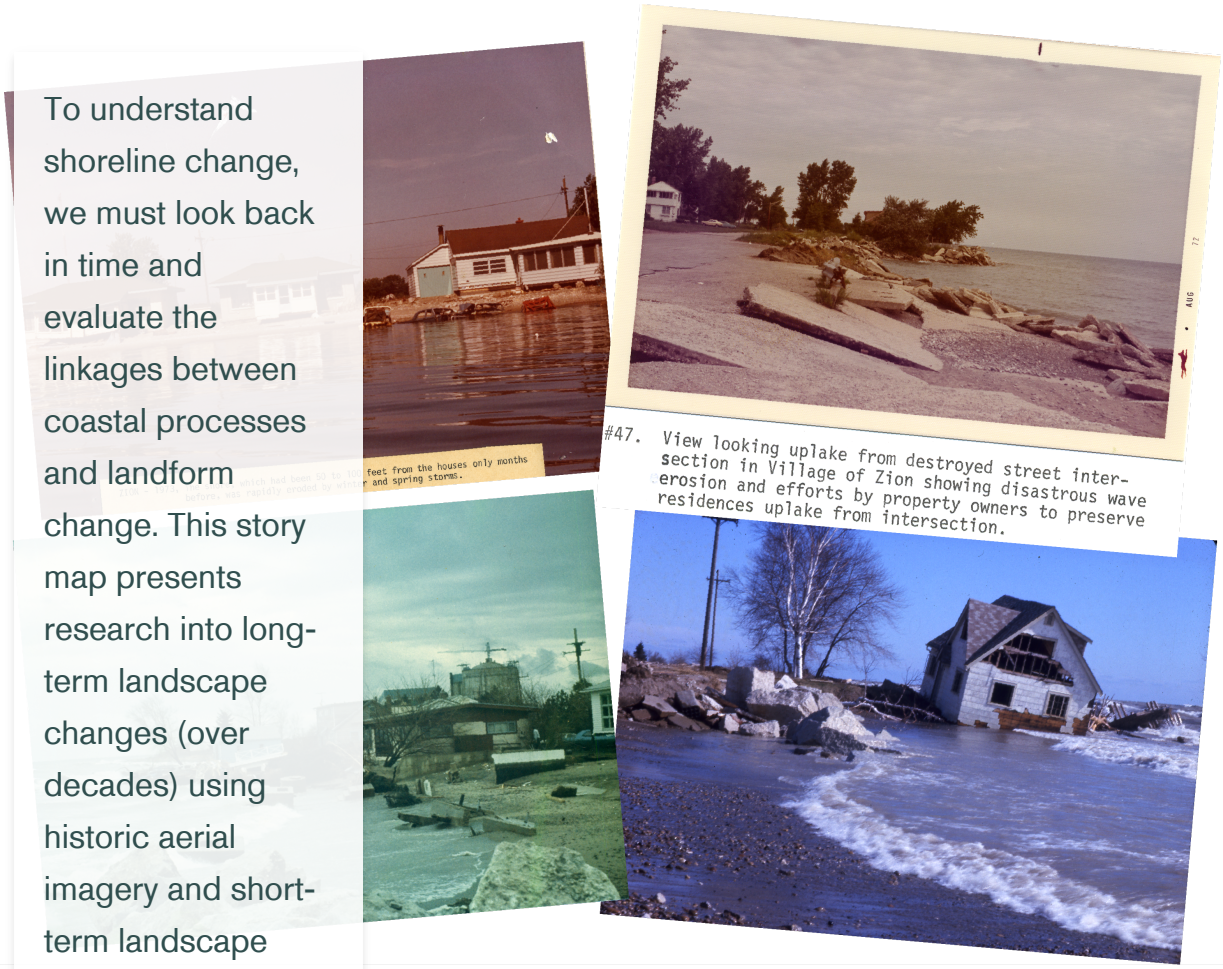
The coastal landscape is dynamic and responds to changes in water level, winter-ice covers, and wind, wave, and current patterns. Many areas along the Illinois coast have recently been impacted by high lake levels, raising concerns over the fate of our vulnerable shorelines.

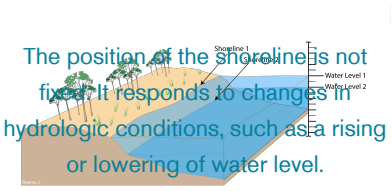


To understand shoreline change, we must look back in time and evaluate the linkages between coastal processes and landform change. This story map presents research into long-term landscape changes (over decades) using historic aerial imagery and short-term landscape changes (over seasonal to year-by-year timescales) evaluated by direct monitoring.

Studying Aerial Imagery

Shoreline changes at IBSP can be reconstructed for the past century using historic aerial images. A look back in time shows us how the coast has changed and how we have interacted with Lake Michigan.

Analysis of historical aerial images is an important component of our understanding of long-term

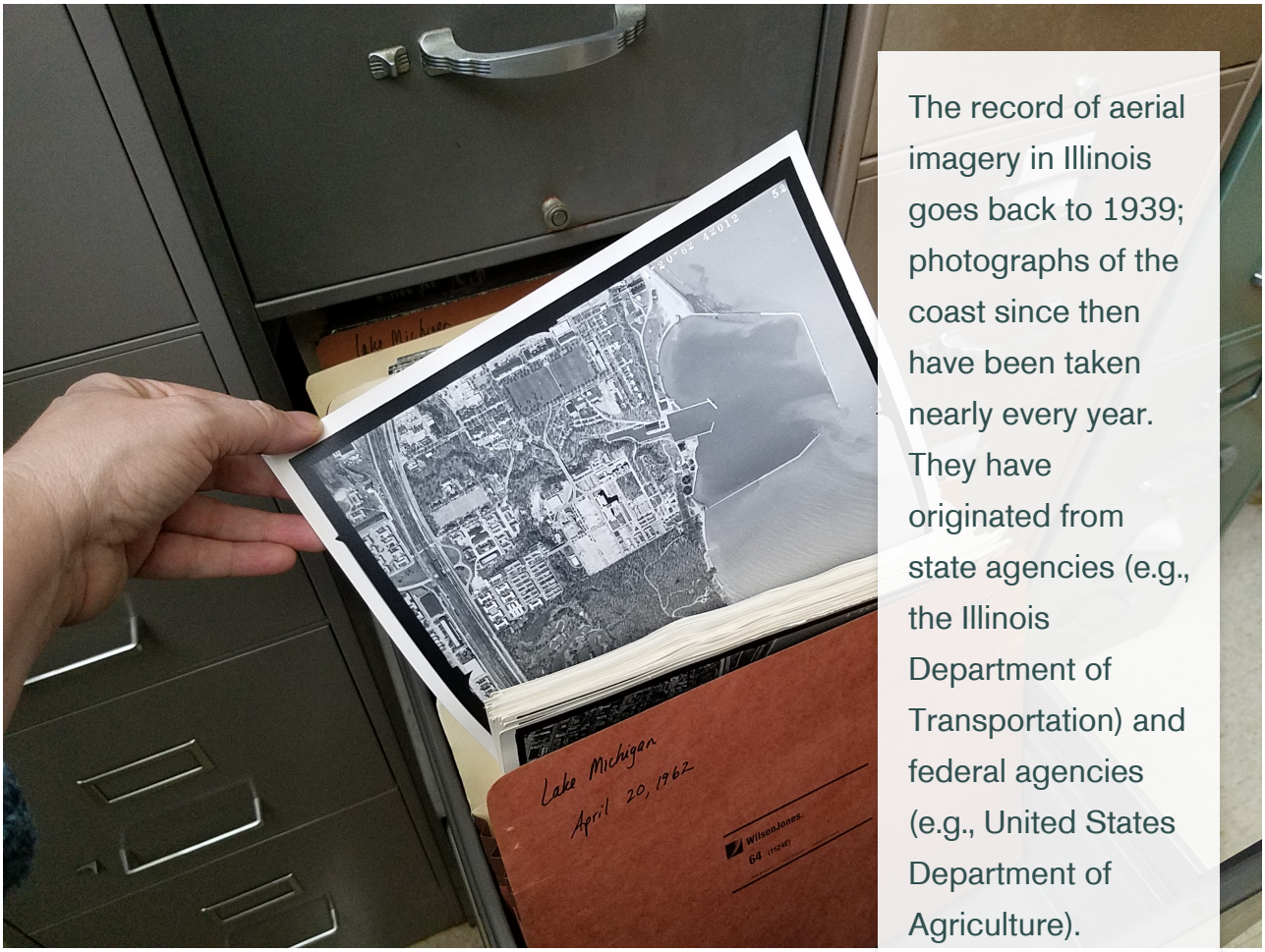


The position of the shoreline is not fixed. It responds to changes in hydrologic conditions, such as a rising or lowering of water level.

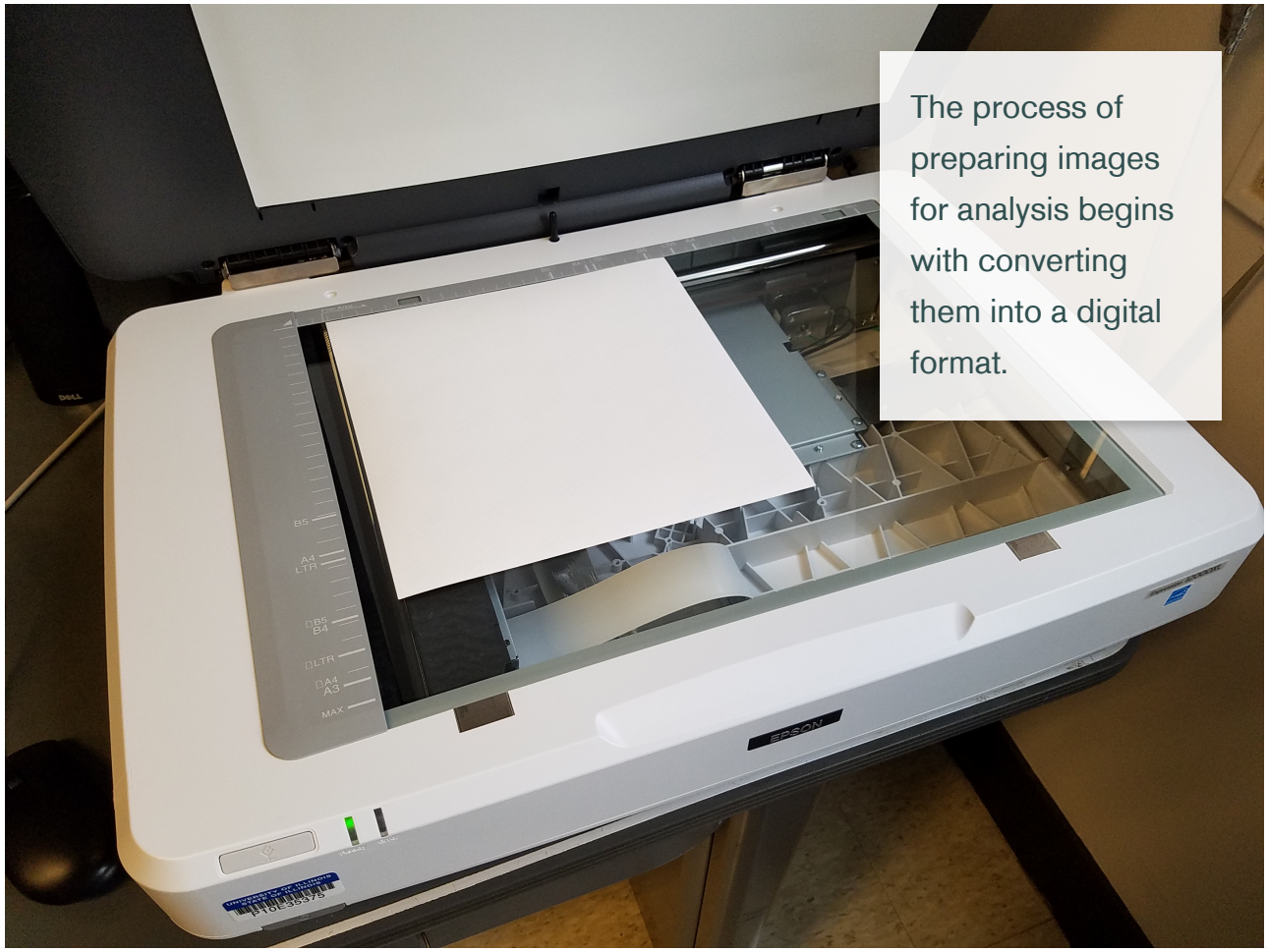
(decades) landscape changes. These images document shoreline positions at a point in time. Changes in the position of the shoreline, which may relate to differences in lake level, can be evaluated from multiple images (see illustration). Tracing former shoreline positions allows us to quantify shoreline retreat (landward movement) and/or shoreline advance (lake-ward movement) between images (over time).

Digital cameras are used to collect aerial imagery today. However, it was not long-ago when aerial photographs were acquired the “old fashioned” way, with film that produced photographic negatives. Such images require an additional processing step before analysis can begin.

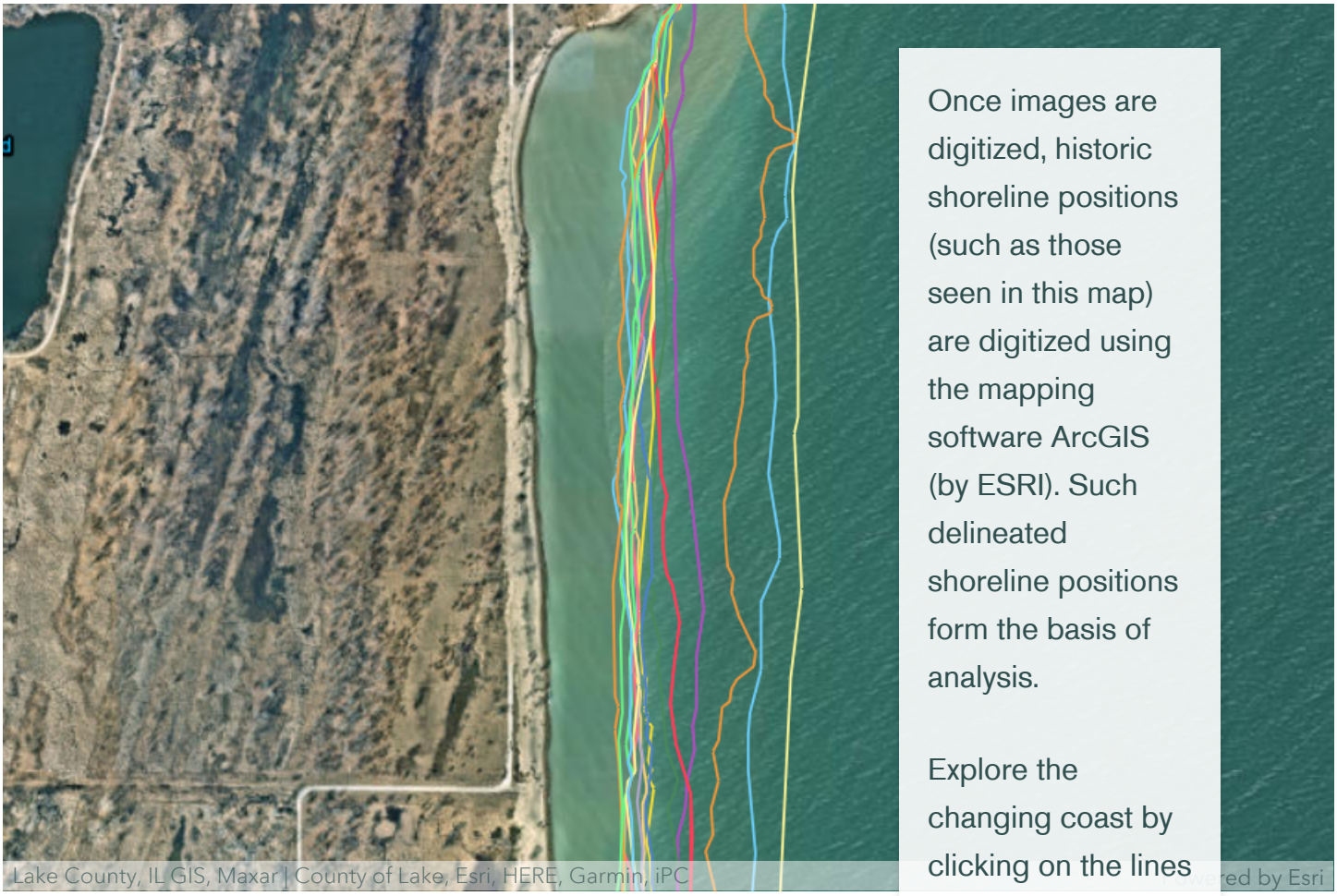
How are these historic images studied?



The record of aerial imagery in Illinois goes back to 1939; photographs of the coast since then have been taken nearly every year. They have originated from state agencies (e.g., the Illinois Department of Transportation) and federal agencies (e.g., United States Department of Agriculture).



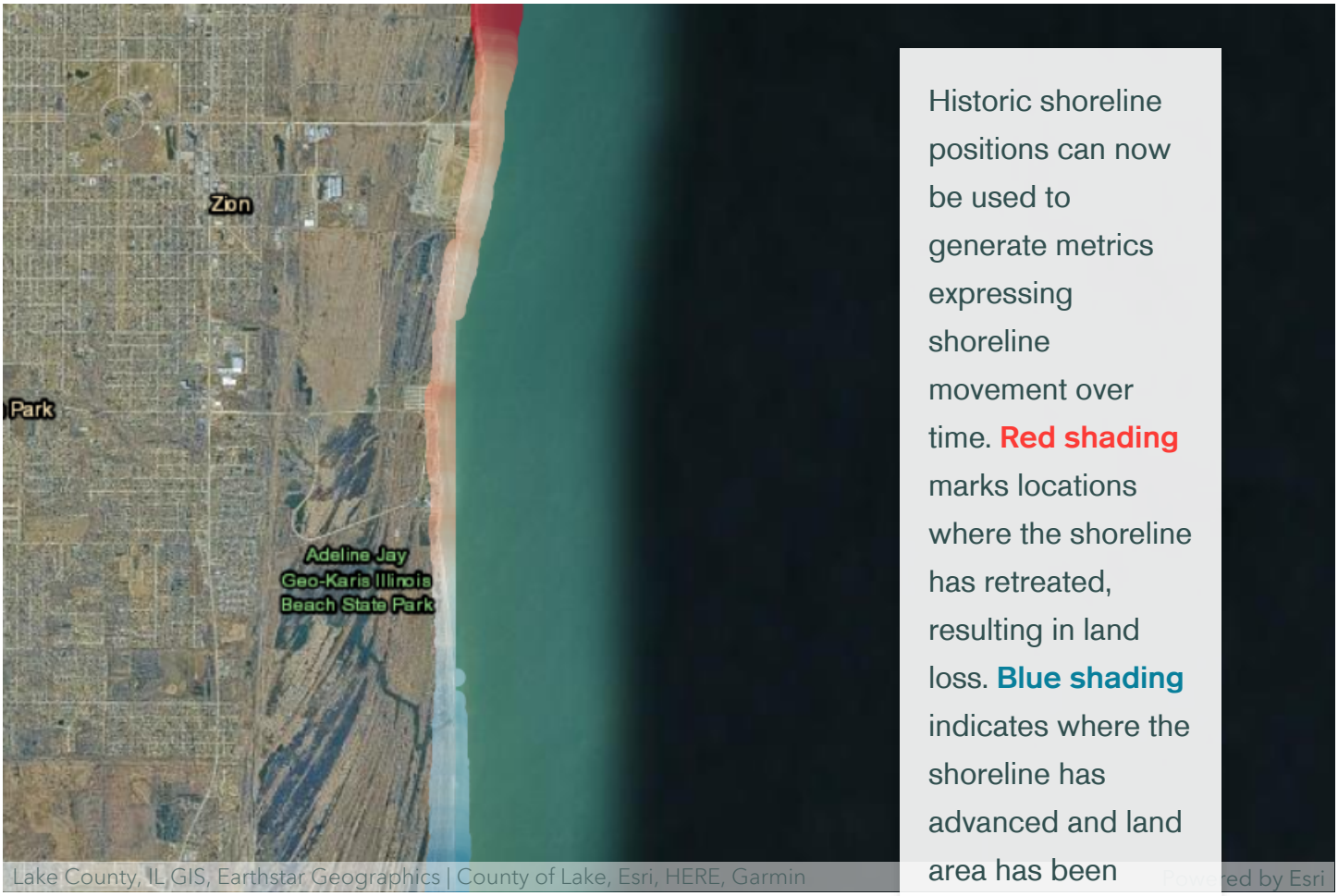
The process of preparing images for analysis begins with converting them into a digital format.



Once images are digitized, historic shoreline positions (such as those seen in this map) are digitized using the mapping software ArcGIS (by ESRI). Such delineated shoreline positions form the basis of analysis.

Explore the changing coast by clicking on the lines to the left – each one represents the approximate shoreline location for a particular year.

(Move the map and zoom in or out to explore historic shoreline positions along the IBSP coast)



Historic shoreline positions can now be used to generate metrics expressing shoreline movement over time. **Red shading** marks locations where the shoreline has retreated, resulting in land loss. **Blue shading** indicates where the shoreline has advanced and land area has been gained. Learn more about this analysis in the Long-Term Change Section.

Drones as a Research Tool

In addition to studying the longer-term evolution of the IBSP shoreline using historic aerial images, we employ advanced drone technology to monitor coastal changes over the short-term. By combining the power of drones and precision of Global Positioning Systems (GPS), we can create high-resolution digital terrain models of the area.

How are drone data acquired and processed?

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In the field, visible black and white targets are placed throughout the monitoring sites as **ground control points (GCPs)**. Their precise locations are recorded using a highly accurate Global Positioning System (GPS). The drone captures photographs of the terrain and these GCPs. Then, the spatial information from the GCPs is affixed to the images so that they can be compared meaningfully at different points in time.

The drone photographs the terrain and the GCPs along preset flight plans that are repeated on a schedule. The sites of investigation are surveyed throughout the year

and after major storm events, which have a high potential to cause change.

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In the lab, drone images and GCP data are uploaded into a special processing software that detects similar features between all the images and creates a point cloud, as shown in this animation. The point cloud contains the photographic information in each point and allows us to determine the elevation of every feature shown in the photo. The GCP data are needed to spatially reference the point cloud

Orthophotographs are created from the point cloud. These are spatially referenced image mosaics. We also create **digital elevation models (DEMs)**, which are 2D representations

of the land surface that contain 3D information. These data products represent detailed depictions of the land surface and allow us to document, map, and quantify coastal change.

Continue to the tabs above to learn more about what historical aerial imagery and drone imagery tells us in the short and long term at Illinois Beach State Park.